# Temporal and Spatial Variations in Fugitive Dust Concentrations in the San Joaquin Valley

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# Outline

- Background
- Temporal and spatial variations in fugitive dust concentrations
- Impact of fugitive dust on mass concentrations
- Diurnal variation in fugitive dust concentrations
- Size distribution of fugitive dust
- Reconciling ambient measurements with emissions inventory
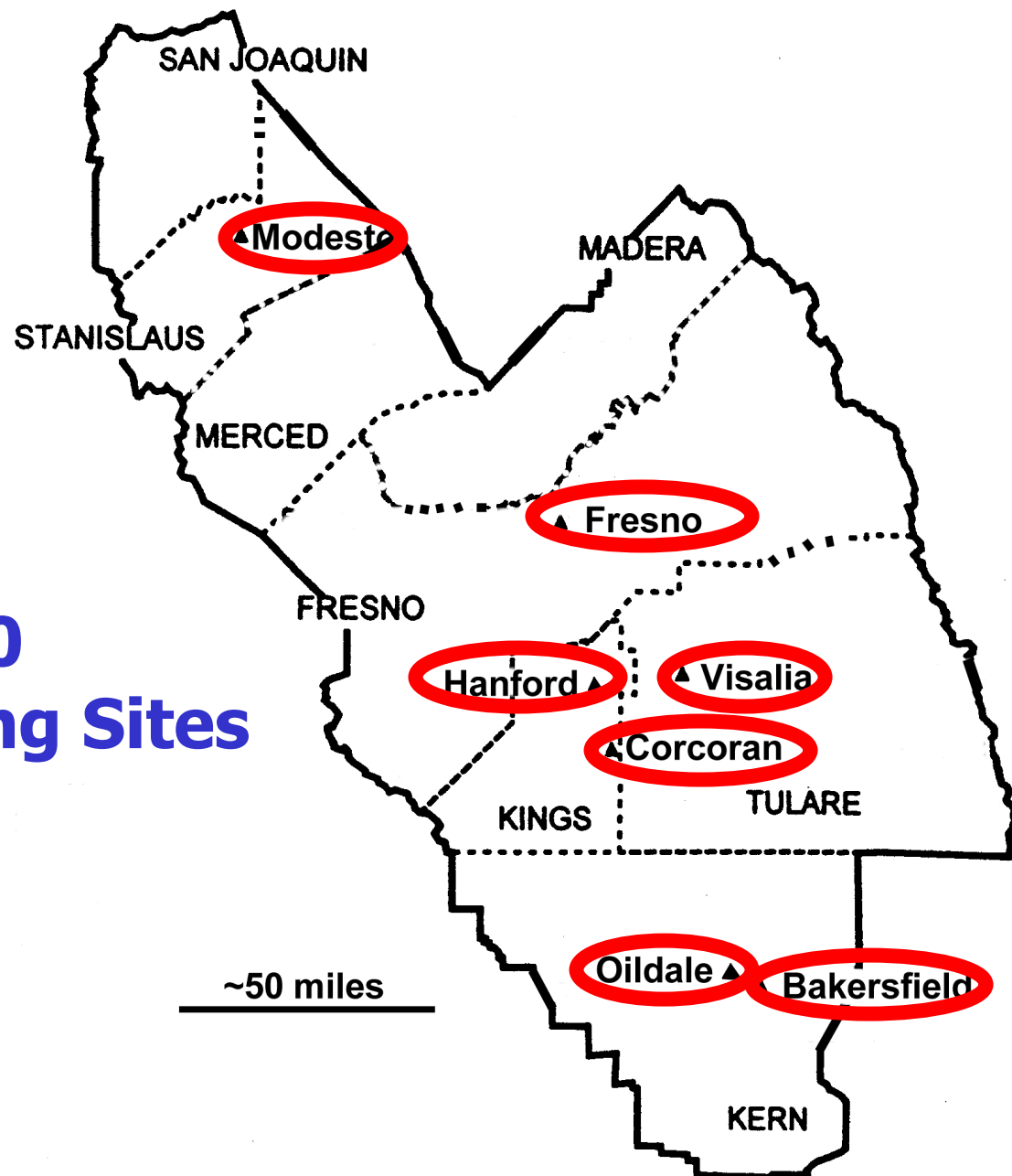- Transportable fraction
- Conclusions

# Background

- San Joaquin Valley Air Basin is classified by EPA as a "serious" nonattainment area for PM10

- Fugitive dust emissions account for ~75% of the PM10 inventory

- This paper summarizes the contribution of fugitive dust to ambient PM10 and PM2.5 levels in the SJVAB based on an analysis of CRPAQS data
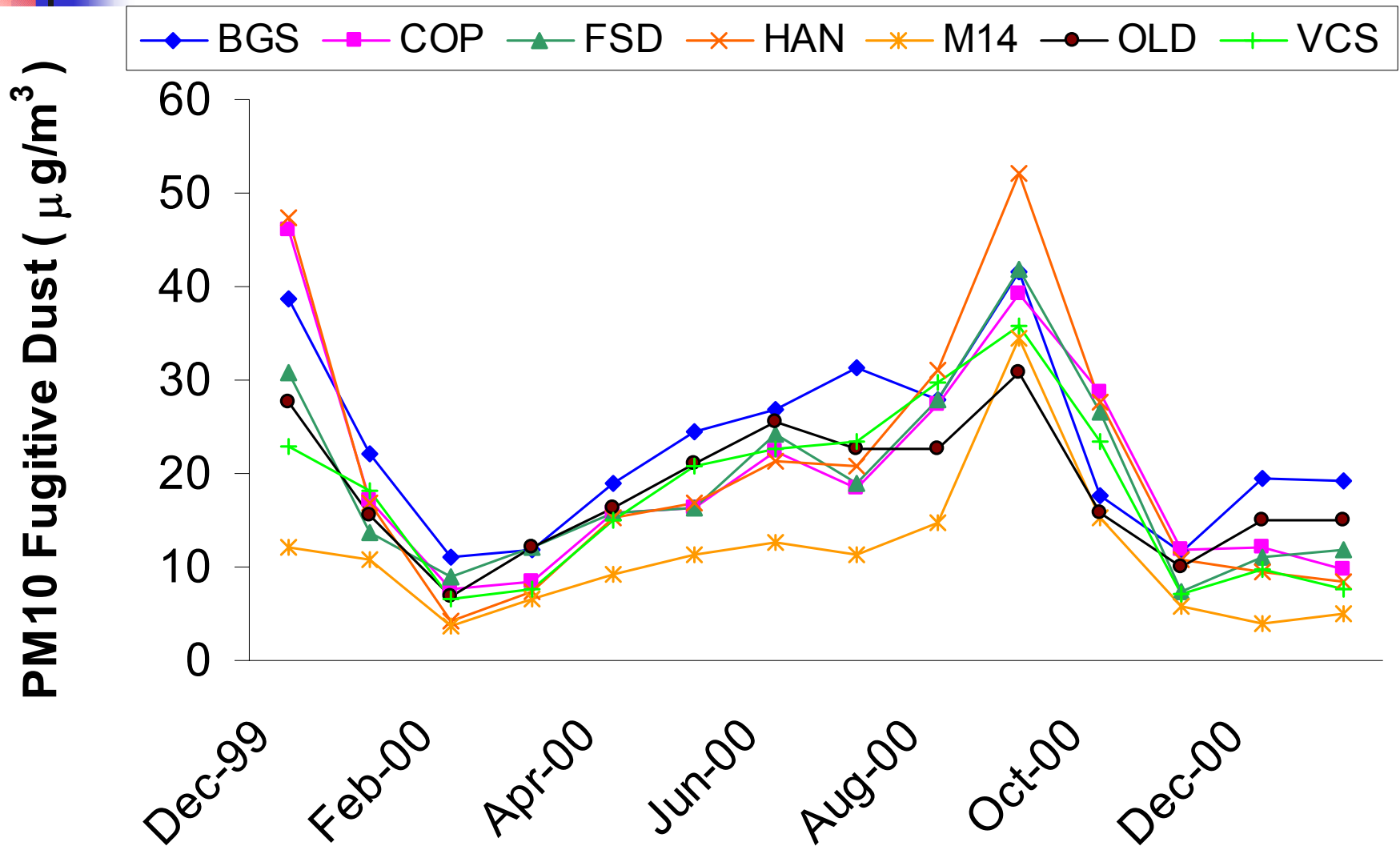
**SJV PM10 Monitoring Sites**

- ▲ Modesto
- ▲ Fresno
- Hanford ▲
- ▲ Visalia
- ▲ Corcoran
- Oildale ▲
- Bakersfield

~50 miles

SAN JOAQUIN

MADERA

STANISLAUS

MERCED

FRESNO

KINGS

TULARE

KERN

# Calculation of Fugitive Dust Concentrations

$$[FD] = 1.89 \, [Al] + 2.14 \, [Si] + 1.40 \, [Ca] + 1.87 \, [Fe] + 1.67 \, [Ti]$$
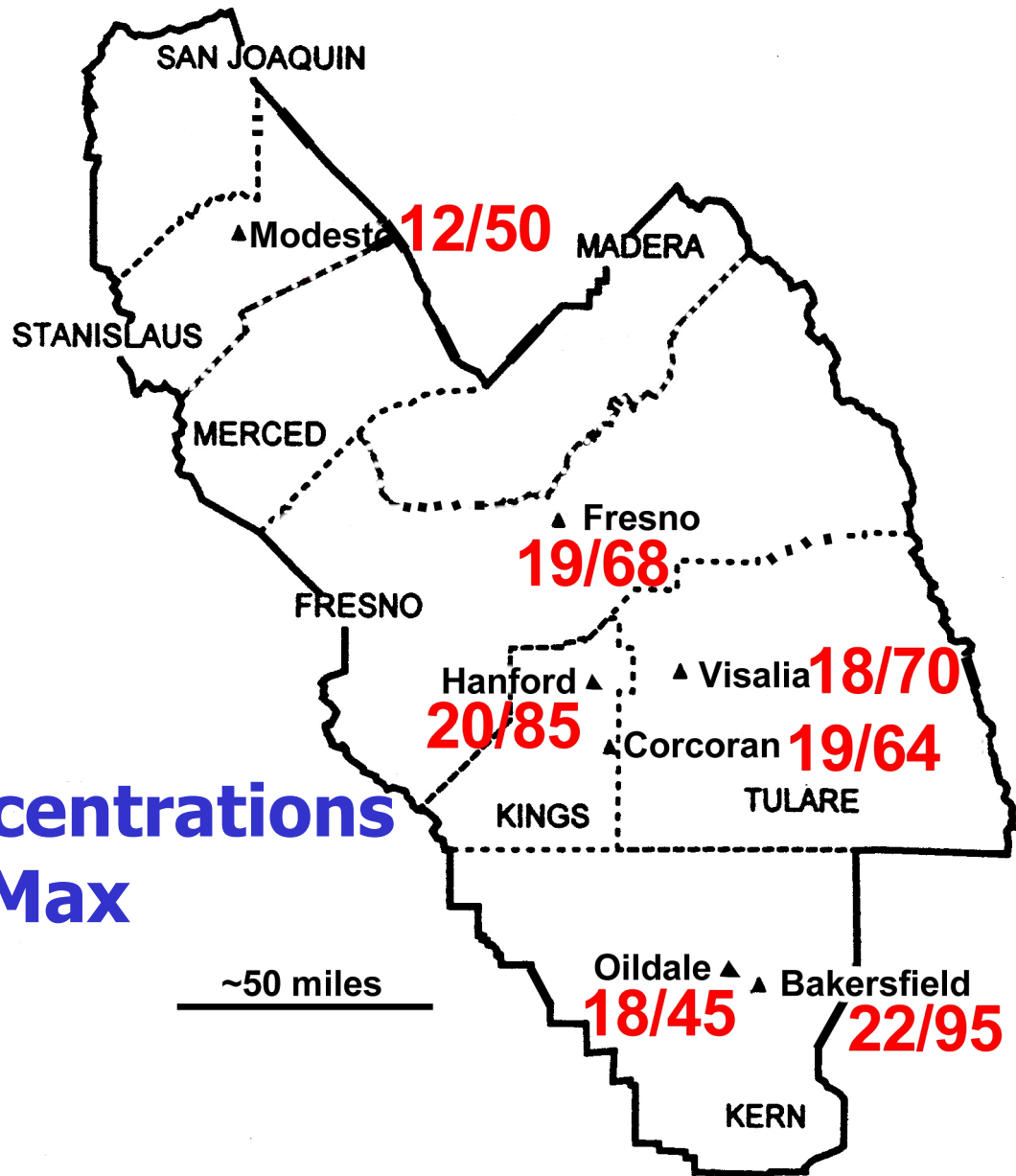
- Assumes major elements associated with soil are present as their predominant oxides

- Factor for Fe includes a term to account for K associated with soil, equal to the total K measured by XRF minus the soluble K associated with vegetative combustion measured by Atomic Absorption

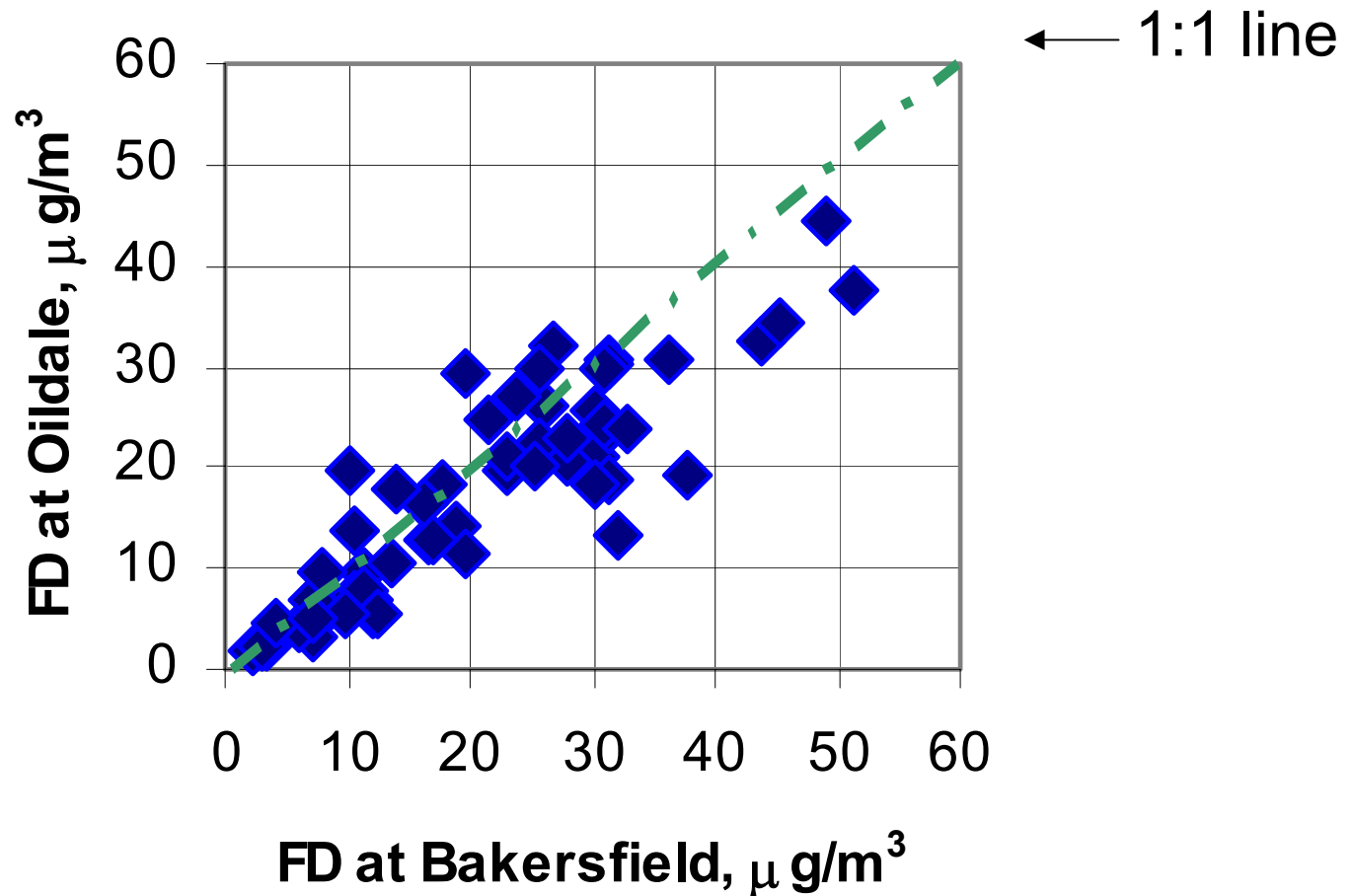# Temporal Variation in PM10 Fugitive Dust Concentrations at 7 Sites (12/99 – 1/01)
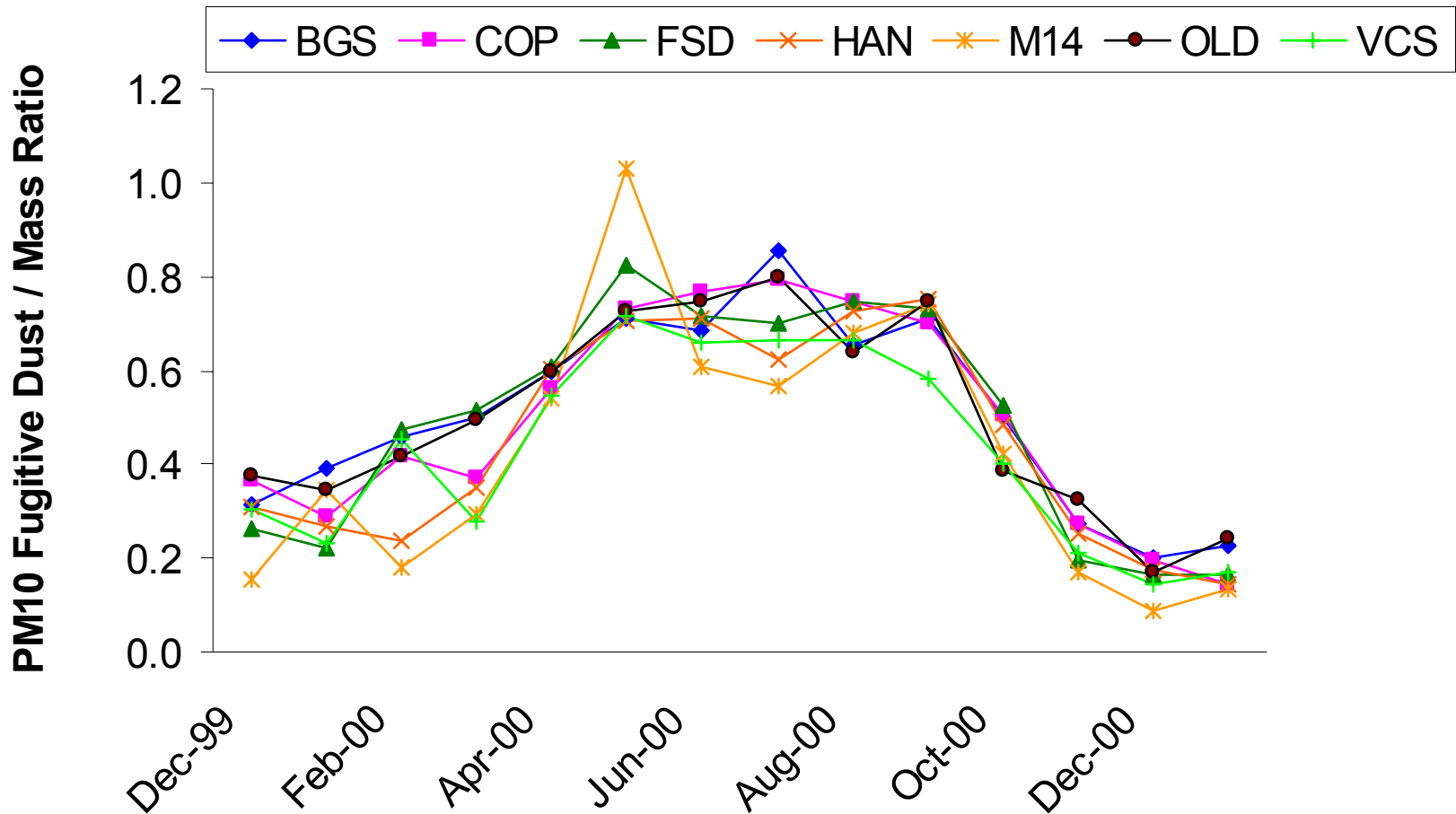
PM10 FD Concentrations
Annual Avg./Max

SAN JOAQUIN

▲Modesto  **12/50**  MADERA

STANISLAUS

MERCED

▲ Fresno
**19/68**

FRESNO

Hanford ▲        ▲ Visalia  **18/70**
**20/85**
                 ▲Corcoran  **19/64**

KINGS           TULARE

~50 miles

Oildale ▲  ▲ Bakersfield
**18/45**  **22/95**

KERN

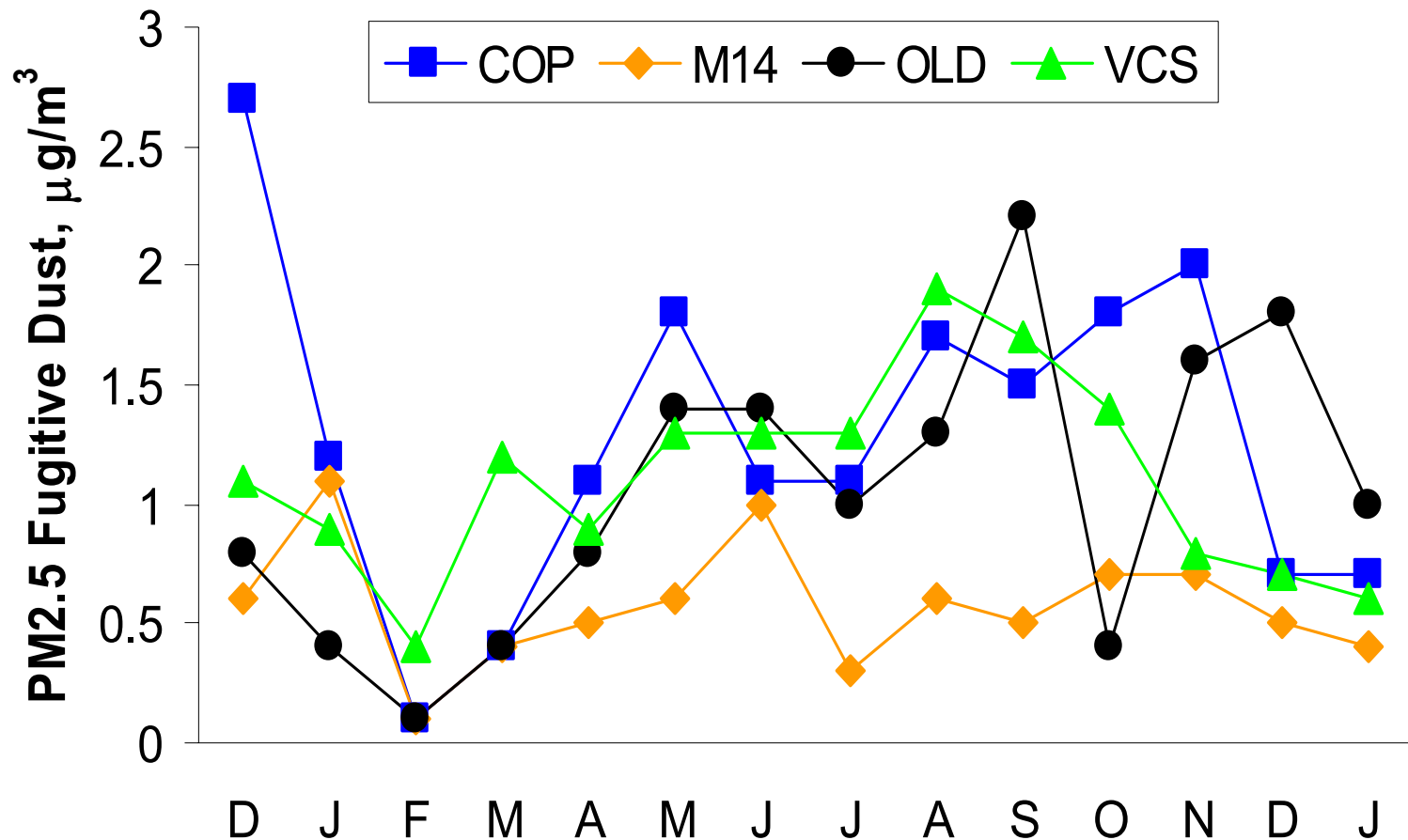# PM10 FD at Oildale vs. Bakersfield
## ($y = 0.76\ x$; $R^2 = 0.772$; $N = 58$)



← 1:1 line

# Temporal Variation in PM10 Fugitive Dust/Mass Ratios (12/99-1/01)

# Temporal Variation in PM2.5 Fugitive Dust Concentrations at 4 Sites (12/99 – 1/01)
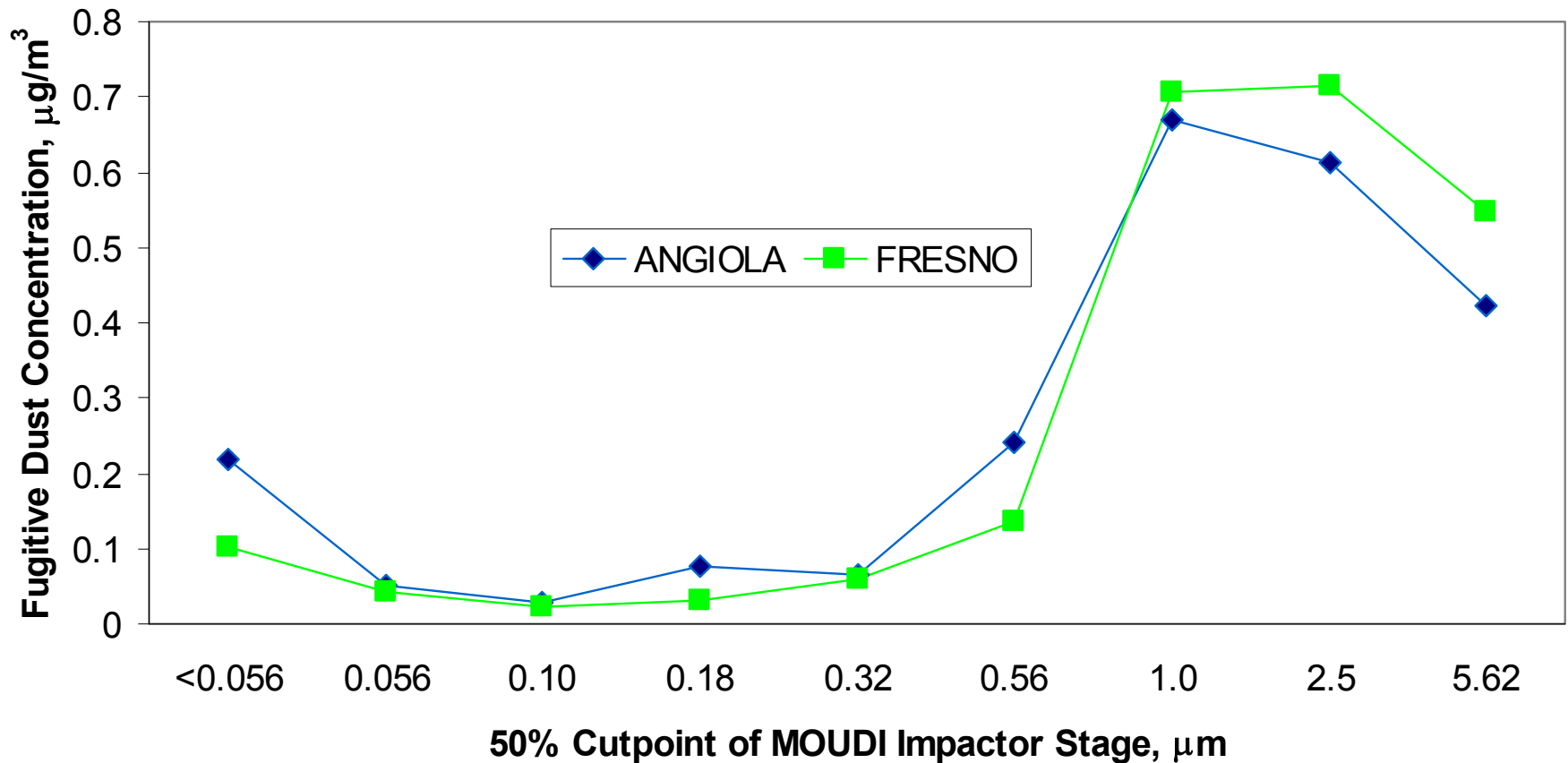
Average Diurnal Variation in PM2.5 Fugitive Dust Concentrations During Winter Intensive (five sampling periods per day)

# Diurnal Variation in PM2.5 Fugitive Dust Concentrations During Winter Intensive
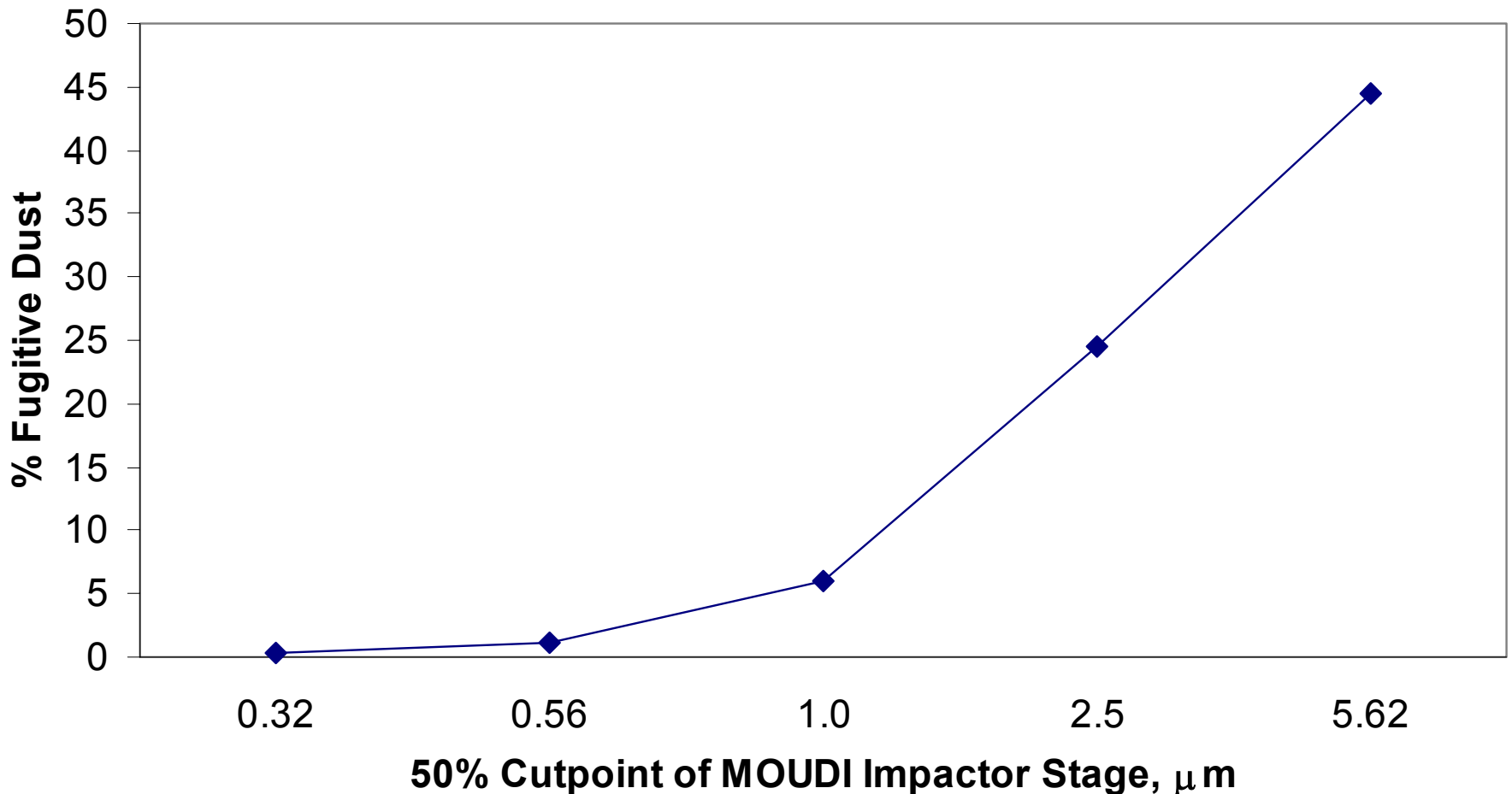## (five sampling periods per day)
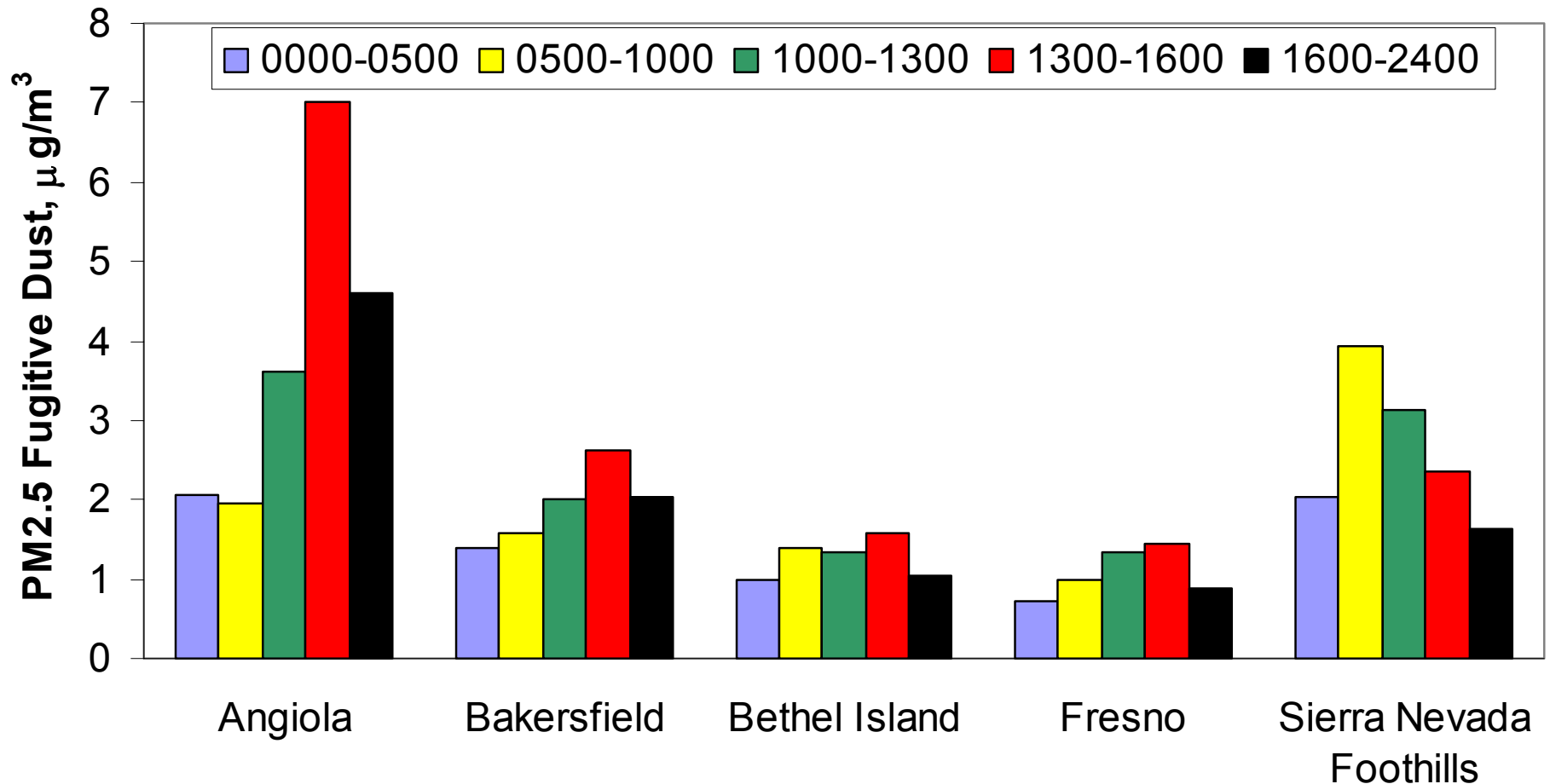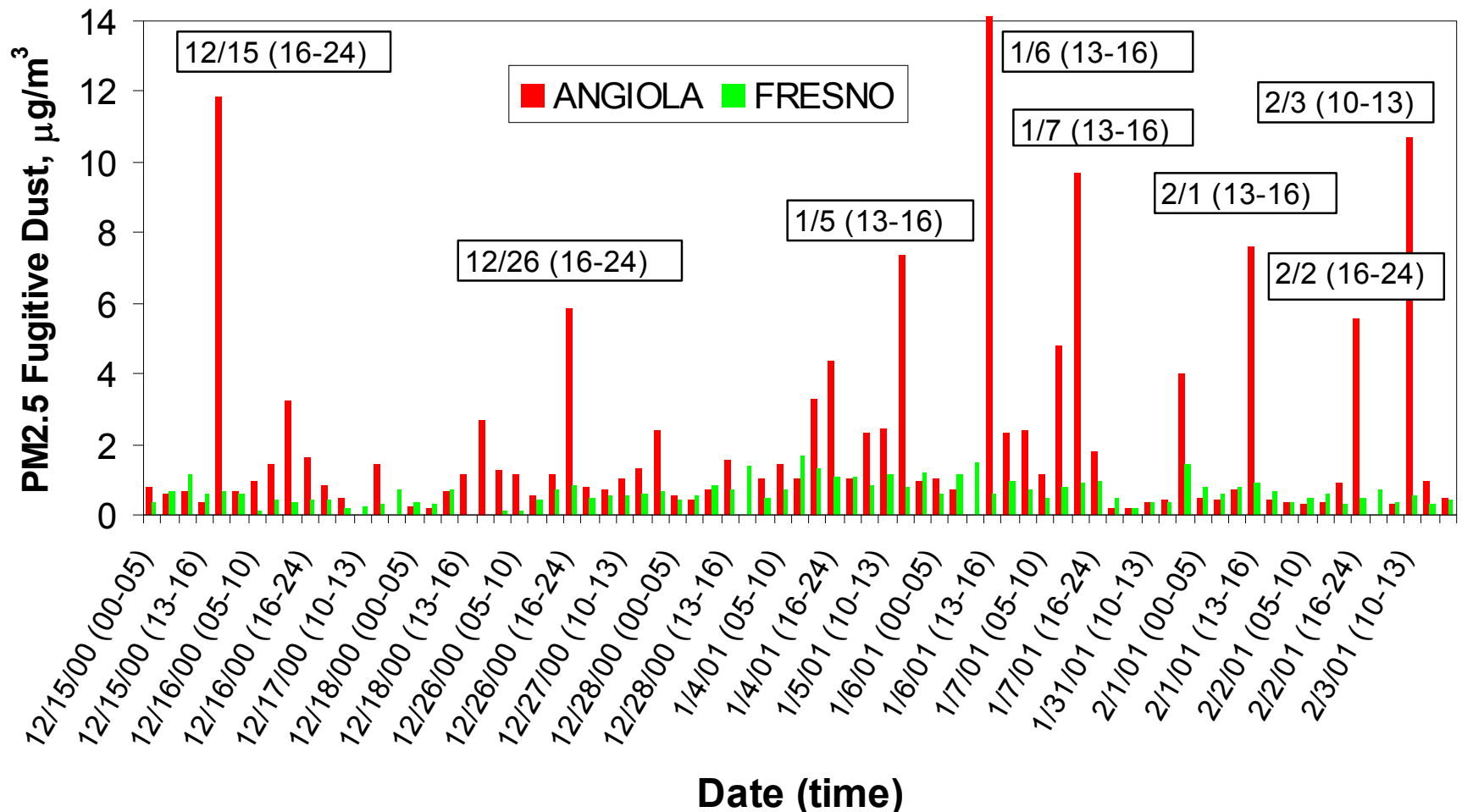
# Average Fugitive Dust Size Distribution at Angiola and Fresno During the Winter Intensive

# Average Contribution of Fugitive Dust to Mass as a Function of Size at Angiola and Fresno During the Winter Intensive
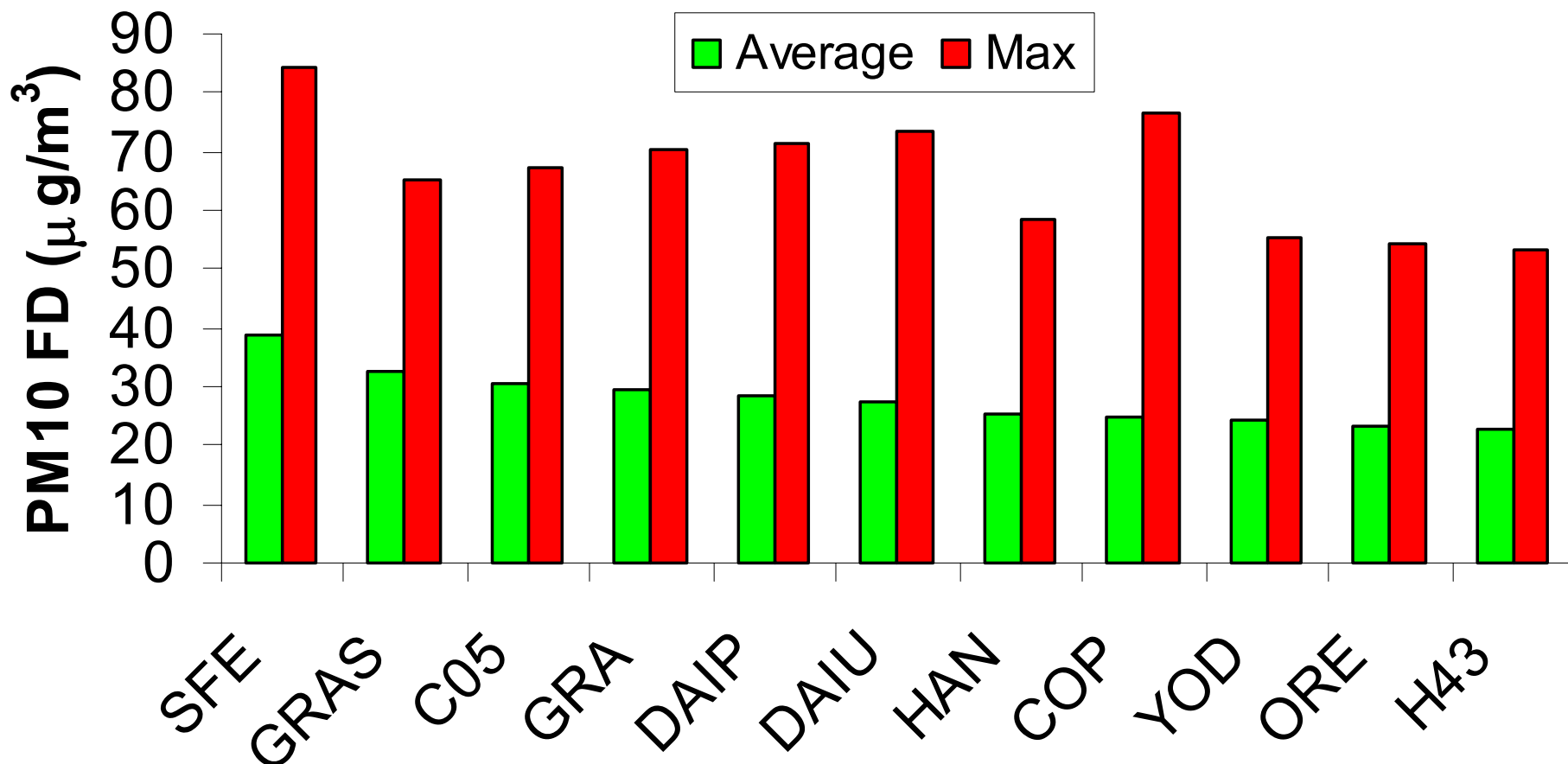
# Reconciling Contribution of Fugitive Dust to PM10 Mass: Measurements vs. Inventory

- $1^o$ Emissions inventory:  FD/Mass = 0.78
- Ambient measurements: FD/Mass = 0.51

Therefore, need to account for secondary aerosol formation and coarse aerosol loss

PM10 Fugitive Dust Concentrations in Kings County During the Fall Intensive

# Transportable Fraction Based on Ambient Measurements in Kings County

Ratio of concentrations at far downwind site (H43) versus near downwind site (SFE), 1 mile apart

- Mass: 0.85
- Ammonium nitrate & ammonium sulfate: 0.98
- Organic aerosol species: 0.85
- Elemental carbon:  1.00
- Fugitive dust: 0.72

(TF based on fractional land cover = 0.74)

# Conclusions Regarding FD Concentrations

- Log-normally distributed
- Large temporal and spatial variations due to different sources and different source strengths:
    - highest in Fall
    - low after precipitation
    - higher on weekdays than weekends (20 vs. 14 $\mu g/m^3$)
    - in the Winter, generally highest in the afternoon
- Accounts for ~50% of PM10 mass on annual basis:
    - ~70% between April and October
    - ~30% for rest of year when $2^o$ ammonium nitrate predominates

# Conclusions Regarding Fugitive Dust

- Majority of fugitive dust is in the coarse size fraction

- Reconciling ambient measurements with emissions inventory requires accounting for secondary aerosol formation and deposition losses for large particles

- Estimate of transportable fraction based on TFs assigned to different land cover categories was in excellent agreement with ambient measurements